OBJECTIVE: PROTECT, CONSERVE, AND RESTORE COASTAL HABITATS AND THEIR BIODIVERSITY

PM: Number of Environmental Technologies and Tools Developed That Enhance Monitoring, Assessment, Management, and Restoration of Coastal Habitats

Prepare preliminary report that identifies the relationships between coral "bleaching" years and the extreme end of the "normal" seasonal variation seen in reef-building corals and determine whether corals transplanted from one depth or site take on characterization of corals living at their new home – in support of remediation efforts. (NURP/Caribbean Marine Research Center, T. Bailey)

Seasonal Monitoring of Tissues of Four Species of Caribbean Reef Corals

William Fitt

Purpose:

The project was designed continue a long-term program of seasonal monitoring of coral tissues and their zooxanthellae of four species of reef-building corals in the Caribbean. Seasonal sampling for *Montastrea annularis* and *Montastrea faveolata* was completed during the first year of the project at Lee Stocking Island. During the second year of support, two additional species were added to the seasonal collections: *Acropora cervicornis* and *Acropora palmata*. During the first half of the second year, reciprocal transplants of the former species were made with enough replicates that a time course of adaptation to the new habitat can be made.

This research was designed to answer the following questions: (1) How much variation is there from year to year in the seasonal patterns seen in tissue biomass and zooxanthellae parameters? (2) Are "bleaching" years really just at the extreme end of the "normal" seasonal variation seen in reef-building corals as suggested by the first year's data? (3) Do corals which are transplanted from one depth/site to another take on characteristics of corals living at their new home? If so, how long does it take? (4) Does data collected from the same species of corals, at the same depths, but in the Florida Keys, differ from patterns seen in the Bahamas? If so, are these differences consistent with any hypotheses concerning Florida Bay water affecting the Florida Reef Tract?

The relationship of severe stresses like coral bleaching to changes in climate is not clear, though many scientists suggest that bleaching may be an indicator of local, regional or global-scale stress. High summer temperatures, coupled with high light intensity (including UV) as well as calm seas have all been implicated as factors responsible for bleaching, and in some cases subsequent death of corals. When climate driven temperature increases, such as during El Niño, coincide with other sources of stress, such as UV light and disease, then bleaching and tissue loss may be induced even more readily and corals may die. Understanding effects of disease, UV and

high light intensities, and bleaching on the health of living corals is virtually impossible without knowing what "normally" happens to a coral over the course of a year. The data collected during the first year of NURP-CMRC funding gives us a good start at understanding the seasonal changes in tissue biomass and zooxanthellae densities and function. Based on the first year's data, it appears that all reef corals "bleach" (i.e., lose pigmentation and numbers of zooxanthellae) every year; though they might not look less brown to the casual observer every year. Only continued monitoring will confirm this pattern.

Objectives:

- Determine natural variation in coral tissue biomass and symbiotic dinoflagellates (zooxanthellae) over seasonal and yearly cycles for five species of coral living at three different depths.
- Determine the relationship of these seasonal cycles to "bleaching" events.
- Determine if transplanted corals take on characteristics of their "new" habitat, or remain similar to those living at the "home" site.
- Compare tissue and zooxanthellae from corals living in the Bahamas with the same corals from the same depths living in the Florida Keys.

Efforts:

Quarterly (seasonal) sampling was conducted during each of the past two years at selected sites near the Caribbean Research Center at Lee Stocking Island, Bahamas. Field and laboratory studies were conducted at the field station and additional laboratory analyses were conducted at the University of Georgia (Athens, Georgia).

Customers:

Customers include resource managers and the public (e.g., recreational divers, fishers, etc.). Results will be disseminated through peer reviewed publications and presentations at scientific meetings.

Results:

- Tissue biomass and zooxanthellae vary with season, coral species, and yearly.
- Bleaching occurs when tissue biomass and symbiotic dinoflagellates are at their lowest levels during the late summer and fall.
- Transplanted corals take on characteristics of their new habitat usually within six months.
- Florida corals look like deep-living Bahamian corals, implying that the water quality/clarity is less in Florida.

Significance:

Results from this study can be used to interpret patterns in the "normal" physiology of corals, as well as periods of time when both the coral and symbiotic dinoflagellates may be experiencing "stress." Such physiological patterns should prove to be quite useful to researchers and managers in assessing both the short and long term status of reef building corals.

Success:

The project was quite successful and further funding for continuation of the study will be solicited. Results of this research were presented at the NCRI conference on "Scientific Aspects of Coral Reef assessment, Monitoring, and Restoration", Ft. Lauderdal, FL. April 14-16, 1999. In addition, two manuscripts have been submitted to peer-reviewed journals:

W.K. Fitt, F. McFarland, M.E. Warner. Submitted Seasonal patterns of tissue biomass and densities of symbiotic dinoflagellates in reef corals, and relation to coral bleaching. Limnology and Oceanography

Warner, M.E., W.K. Fitt, G.W. Schmidt. In Press Damage to photosystem Ii in symbiotic dinoflagellates: a probable cause of coral bleaching. Proc. Natl. Acad. Sci.